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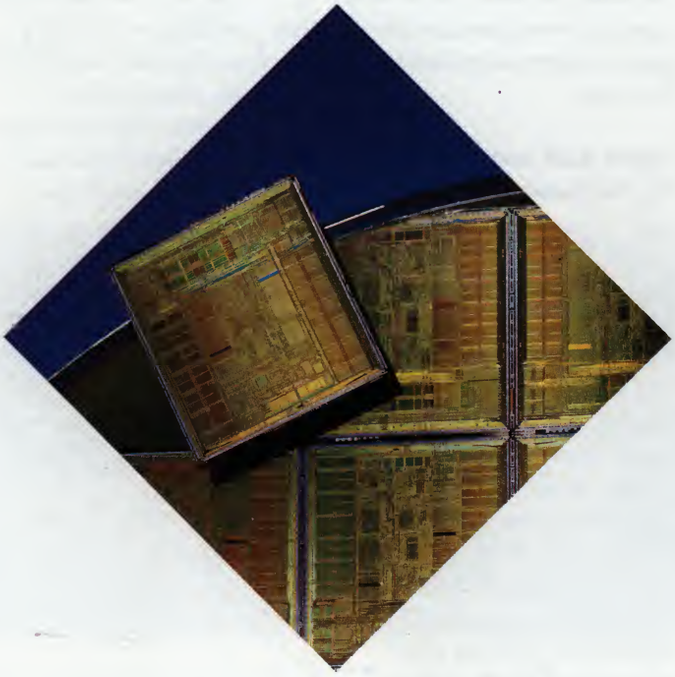
Alpha AXP Microprocessors

Alpha AXP 21164 Microprocessor

The world's highest performance microprocessor

Digital's Alpha AXP 21164 Microprocessor is the first microprocessor to deliver performance greater than one billion instructions per second (BIPS). This second-generation Alpha AXP microprocessor packs the power to drive the most demanding servers, and high performance client systems.



Four-way issue instruction superscalar operation and the industry's first on-chip level 2 cache contribute to the 21164 microprocessor's record-setting performance. A flexible, high performance interface further boosts throughput and makes it easy to design 21164 microprocessor-based systems ranging from uniprocessor PCs to multiprocessor datacenter servers. And, as a merchant semiconductor vendor committed to excellence of design as well as product support, Digital provides a suite of design tools, including an evaluation board and a PCI core logic chipset, to help you bring Alpha AXP 21164 microprocessor-based systems to market faster and at a lower cost.

Power and leadership performance

The first 21164 microprocessors — the 21164-266 and 21164-300 — operate at speeds of 266 MHz and 300 MHz respectively, underlining Digital's commitment to its product roadmap of high performance microprocessors. This leadership performance, combined with a choice of operating systems, including Windows NT, OSF/1, OpenVMS, and more than 5,000 applications, allows you to develop winning new system solutions for the most demanding users and applications.

ALPHA™ GENERATION

Highlights

- **The highest performance in the industry — 330 SPECint92 and 500 SPECfp92 — enables new system solutions for the most demanding users and applications**
- **Alpha AXP architecture provides scalability, operating system choice, and investment protection**
- **On-chip level 2 cache boosts throughput and reduces system cost**
- **Flexible, high performance interface provides design choice for price/performance tradeoffs**

Alpha AXP architecture: leadership that endures

Digital's Alpha AXP 64-bit RISC architecture emphasizes high performance, longevity, and expandability. Superpipelining, multiple instruction issue, multiprocessor support and other architecture features provide very high throughput that can be increased with each new Alpha AXP microprocessor design.

Complementing Alpha AXP's unparalleled performance capabilities is the architecture's exceptional flexibility. Designed as an open solution platform, Alpha AXP supports multiple operating systems including Windows NT, OSF/1, and OpenVMS.

Alpha AXP microprocessor family: designed for performance

Alpha AXP microprocessors implement the powerful Alpha AXP architecture in designs that take full advantage of Digital's well-known leadership in sub-micron CMOS process technology. Experienced Digital design engineers, backed by sophisticated Digital CAD tools, harness this technology to create standard-setting Alpha AXP microprocessors.

The result is semiconductors with leadership performance that has been unchallenged since the introduction of the first Alpha AXP microprocessor. As new microprocessors are added to the Alpha AXP family, this performance advantage continues to grow. With the Alpha AXP family of high performance chips, you can deliver leadership products that satisfy a broad spectrum of customer price/performance requirements, today and into the future.

Alpha AXP and the emerging Windows NT market

Only Alpha AXP microprocessors have the power to unleash the full potential of the Windows NT operating system. Alpha AXP microprocessors running a Windows NT Workstation or Windows NT Server deliver flexible and exceptionally powerful solutions for client/server and power user applications. More Windows NT applications are currently available or committed to the Alpha AXP platform than to any other RISC platform, including PowerPC and MIPS. That means that you can take advantage of this powerful solution today. Digital's robust ISV program helps speed software porting and development, ensures that even more applications will be available soon.

PCI: the high-bandwidth bus for the 90s

The Peripheral Component Interconnect (PCI) bus supports applications requiring high performance graphics and high-bandwidth peripherals. Digital is a leader and innovator in bringing this industry standard bus to market and supports PCI capabilities for every Alpha AXP microprocessor. Using this capability and PCI-based peripheral chips, you can design Alpha AXP systems that offer workstation-class performance with volume- priced, off-the-shelf peripherals.

Design support

You can turn the power advantage of Alpha AXP microprocessors into revenue quickly and cost effectively by selecting from Digital's comprehensive suite of services and support tools. Digital's design experts and field application engineers can provide assistance geared to your specific design and implementation needs. In addition, evaluation board kits, logic analyzers, computer-aided design models and other tools simplify hardware design and testing.

Alpha AXP 21164 Microprocessor: setting the standard for performance and flexibility

The Alpha AXP 21164 microprocessor, the most powerful microprocessor available, boasts ratings of up to 1.20 BIPS, supporting both client and server applications. The 21164-266 microprocessor offers an estimated 290 SPECint92 and 440 SPECfp92 while the 21164-300 microprocessor delivers even greater performance with an estimated 330 SPECint92 and 500 SPECfp92. With this extraordinary performance, 21164 microprocessors are ideally suited to high performance client applications such as computer aided design (CAD), computer assisted software engineering (CASE), publishing and imaging, high-end graphics, multimedia, scientific and financial analysis, as well as power hungry server applications, including database, networking, and groupware.

As the highest performance Alpha AXP microprocessor, the 21164 complements the performance range of other members of the Alpha AXP microprocessor family and extends Alpha AXP system solution possibilities dramatically. The 21164 microprocessor is designed to satisfy the most demanding users and application environments across a wide range of industries.

Alpha AXP 21164 microprocessor features

4-way instruction issue
The 21164 microprocessor is a superscalar design that permits two integer instructions and two floating point instructions to be issued every clock cycle. The exceptional throughput provided by this Alpha AXP design allows CPU-intensive applications to run at speeds previously possible only in large datacenter systems.

On-chip cache
Featuring two levels of on-chip cache, the 21164 offers the high speed data access required in performance-focused microprocessors. The 21164 microprocessor integrates:

- On-chip 8K byte direct-mapped write-through level 1 data cache
- On-chip 8K byte direct-mapped level 1 instruction cache
- On-chip 96K byte three-way set-associative writeback level 2 cache

With the large on-chip level 2 cache — the first in the industry — the 21164 microprocessor reduces overall system costs in some applications by eliminating the need for level 3 cache on the board.

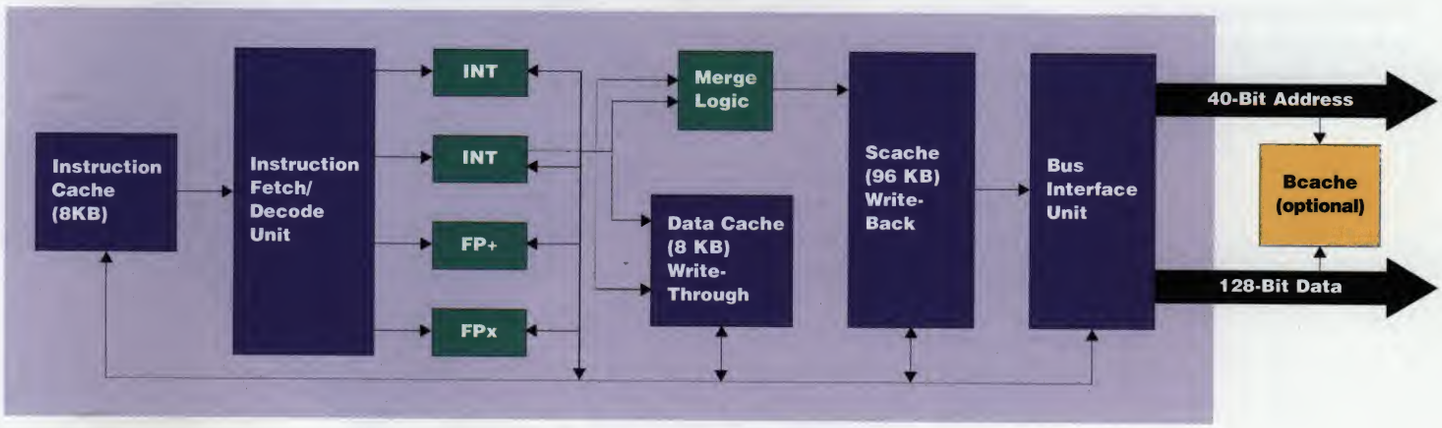
High performance interface
The 21164 microprocessor high performance interface provides lightning fast access to main memory, data buses and optional board-level cache.

This exceptionally flexible interface features:

- A 128-bit memory data path
- 40-bit addressing
- Selectable ECC or parity protection
- Control for optional external level 3 cache
- Progammable cache speed, one-third to one-fifteenth of clock speed

These and other choices provided by the 21164 microprocessor interface enable you to build products that satisfy a broad spectrum of customer price and performance needs.

5-volt-tolerant inputs: wide choice of components
The 21164 microprocessor interfaces directly to components operating at a a supply voltage of 3.3 V or 5.0 V. That means you can use standard components that best fit your applications and market demands.



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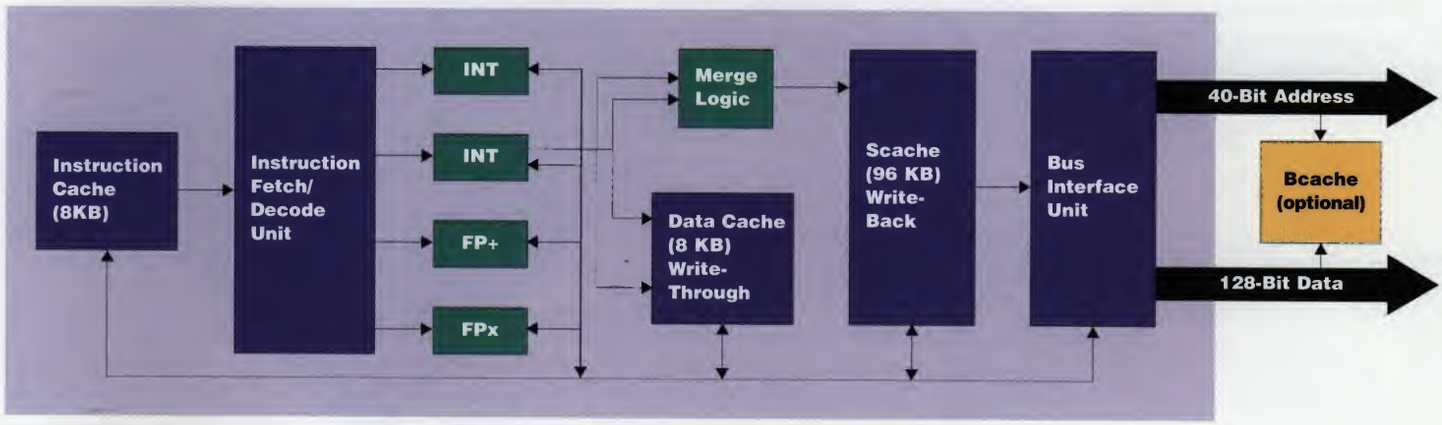

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For more information

To learn more about availability of the Alpha AXP 21164 microprocessor, contact your Digital sales representative or your local chip distributor. To learn more about Digital's semiconductors, contact the Semiconductor Information Line: 1-800-332-2717, 1-800-332-2515 (TTY). Outside North America, call: +1-508-568-6868.

Specifications	
Cycle Time	266 MHz (3.7 ns) / 300 MHz (3.3 ns)
Transistor Count	9.3 million
Package	499-pin ceramic interstitial through-hole PGA
Number of Signal Pins	290
Power Dissipation	40 max at VDD=3.45 V, Freq. = 266 MHz
Power Supply	3.3 volts
Clocking Input	Two times the clock speed
On-chip level 1 D-cache	8 Kbyte, physical, direct-mapped, write-through, 32-byte blocks
On-chip level 1 I-cache	8 Kbyte, virtual, ASN support
On-chip DTB	64-entry. fully associative, ASN support
On-chip ITB	48-entry, fully associative, ASN support
On-chip level 2 cache	96 Kbyte three-way set-associative write back, 32-byte or 64-byte blocks
Floating Point Unit	On-chip FPU supports both IEEE and VAX floating point
Bus	Separate data and address bus, 128-bit/64-bit data bus
Serial ROM Interface	Allows the chip to directly access serial ROM
Virtual Address Size	64 bits checked, 43 bits implemented
Physical Address Size	40 bits implemented
Page Size	8 Kbytes
Issue Rate	2 integer instructions and 2 floating point instructions per cycle
Integer Pipeline	7-stage pipeline
Floating Pipeline	9-stage pipeline

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